Ultra-Long Duration Balloon
Control Center
Product Plan

Signature Page

Submitted:

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Approved:

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Disclaimer

This document supercedes all other Product Plans and Software Development Management Plans written for the ULDB Control Center development effort.

The controlled copy of this document is available on-line at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. Printed copies of this document are for reference purposes only. It is the user's responsibility to verify that the version of any printed documentation matches the on-line version.

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1.0 Introduction

This document is intended to describe the plan for the development of the Ultra-Long Duration Balloon (ULDB) Control Center. This document shall be the basis for formal agreements between the Balloon Programs Office and the ULDB Control Center development team.

1.1 Purpose

The purpose of the ULDB Control Center software effort is to provide ULDB scientists, engineers, and mission operators with software tools with which they can monitor the status of and issue commands to ULDB instruments. The control center systems will support integration, pre-launch checkout, launch, float, and terminate operations.

1.2 Background

Recent advances in composite super-pressure balloon materials have greatly enhanced the prospects for very long duration balloon flights on Earth as well as possible use for planetary exploration. NASA is embarking on the development of technologies to support extended balloon missions lasting up to 100 days (~5 circumnavigations of the globe) above 99.9% of Earth's atmosphere.

The ULDB objective is to develop a low cost, integrated, advanced, long duration balloon system which is technically feasible and within program cost constraints while maintaining the existing balloon program. The ULDB program is significantly different from the current balloon program in that the expected science return is significantly greater than current balloon missions. In other words, it is more than simply extending current experiments over a longer time period. This program also expects to use technologies currently available in the spacecraft missions and commercial arenas to improve performance while containing costs.

1.3 Product Plan Review and Update

This document shall be reviewed by members of the Balloon Programs Office associated with the ULDB project, other ULDB subsystems leads, and Real-Time Software and Engineering Branch (RTSEB) managers. The ULDB Project Manager, ULDB Mission and Operations Manager, ULDB System Engineer and Balloon-craft Manager, and RTSEB Management shall have approval authority for the plan.

This document has been developed by and shall be maintained by the ULDB Control Center Lead. It may be updated to reflect changes in the project objectives.

2.0 Customer Agreement

This section describes the agreement between the ULDB Control Center customer and the ULDB Control Center development team including those issues related to requirements, deliverables, and maintenance.

2.1 Customer Identification

The primary customer for the products developed by this effort is the Balloon Programs Office. The project has relevancy to the Earth Science Enterprise and the Space Science Enterprise as defined in NASA's strategic plan.

2.2 Customer Goals and Objectives

The customer's objective with respect to the ULDB Control Center is to be provided with tools with which ULDB instruments can be controlled and monitored. These tools are to be located at the launch site and at the ULDB Control Center facility in Palestine, TX. Other tools will be accessible to users via the World Wide Web. The tools will provide data and accept commands from scientists, engineers, and operators.

2.3 Requirements

The ULDB Control Center will include several systems that are designed to coordinate communication between scientists, engineers, and operations personnel and the balloon-craft and science instruments. A stationary computer-based data handling and processing system will be provided to support float and terminate operations. This system will be placed in the ULDB Operations Control Center and shall be referred to as the Operations Control Center (OCC). A transportable computer-based data handling and processing system shall be provided to support integration, pre-launch checkout, launch, float, and terminate operations. This portable system shall be referred to as the Remote Operations Control Center (ROCC).

Six OCC/ROCC functional areas have been defined to support ULDB operations. Some of the defined functional areas represent individual subsystems in the physical control center implementation others will be combined into one or more physical subsystems. The functional areas are General System, Telemetry Acquisition, Command, Data Management, Real Time Monitor and Control, and Data Analysis.

The OCC and the ROCC will use the Space Network (SN), INMARSAT, Iridium, and ARGOS networks to obtain forward and return link data communications. In addition, the ROCC will use Line-of-Sight (LOS) networks. Both systems will provide tools used to manage the planned operations of the ULDB missions. The systems will provide the capability to receive, process, and monitor telemetry data from the balloon-craft. They will provide the capability to validate, build, up-link, and verify real time commands for the ULDB balloon-craft and instruments. They will provide up-link and verify memory loads for the balloon-craft and instruments and verify execution of stored commands for the balloon-craft and instruments during a real time contact. The systems will provide a Project Data Base (PDB) containing information necessary to support mission operations. Telemetry, command, and constraint definitions will be maintained within a PDB for each mission. The system will include Operations and Engineering interfaces that provide users with the ability to monitor and control the balloon-craft instruments. The systems will provide analysis capabilities to maintain the health and safety of the ULDB balloon-craft and instruments. The analysis function will provide ULDB operations personnel with the tools necessary to perform balloon-craft systems management, performance analysis, trend analysis, fault detection, isolation, and recovery, and configuration management.

A computer-based software system shall be provided to monitor balloon-craft and science instruments and provide limited control of those instruments. This system shall be referred to as the Remote Monitor and Control System (RMCS).

For a detailed description of the functional requirements refer to the <u>ULDB Control Center Requirements and Functional Specifications</u> document linked to the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

2.4 Deliverables

The products to be delivered by the conclusion of this project include the following configuration items:

4.2.3.1	Control Center development and test system; including: one CPU, one monitor, Linux, Motif, ITOS, SatTrack, and all associated documentation.
4.3.3.1	ROCC workstation #1; including: one CPU, one monitor, Linux, Motif, ITOS, SatTrack, and all associated documentation.
4.3.3.2	ROCC workstation #2; including: one CPU, one monitor, Linux, Motif, ITOS, SatTrack, and all associated documentation.
4.3.3.3	ROCC analysis workstation; including one CPU, one monitor, Windows NT, Microsoft Office, and all associated documentation.
4.3.3.4	ROCC printer.
4.4.3.1	OCC workstation #1; including: one CPU, two monitors, Linux, Motif, ITOS, SatTrack, and all associated documentation.
4.4.3.2	OCC workstation #2; including: one CPU, two monitors, Linux, Motif, ITOS, SatTrack, and all associated documentation.
4.4.3.3	OCC workstation #3; including: one CPU, one monitor, Linux, Motif, ITOS, and all associated documentation.
4.4.3.4	OCC analysis workstation; including one CPU, one monitor, Windows NT, Microsoft Office, and all associated documentation.
4.4.3.5	OCC web server; including all server software and associated documentation.
4.4.3.6	OCC RAID storage system.
4.4.3.7	OCC printer.

2.5 Necessary Customer Training

Mission operators identified by the customer will be trained in mission setup procedures, normal operating procedures, and system recovery procedures. Training will be conducted at the ULDB Operations Control Center at the National Scientific Balloon Facility (NSBF).

2.6 Medium for Product Delivery

Commercial Off-the-Shelf (COTS) products incorporated into the product shall be delivered to the appropriate destination(s) as they are delivered from the vendor. Government Off-the-Shelf (GOTS) products shall be delivered on CDROM or 3.5 inch floppy disk.

2.7 Product Destination

The OCC, including all associated hardware and software, will be located in the ULDB Operations Control Center at the National Scientific Balloon Facility (NSBF).

The ROCC, including all associated hardware and software, will be located at the launch site.

The RMCS software will be installed on a World Wide Web server located at the ULDB Operations Control Center at the National Scientific Balloon Facility (NSBF).

2.8 Post Delivery Maintenance

Maintenance to the ULDB Control Center software will be the responsibility of the ULDB Control Center development team. All modifications to the ULDB Control Center software needed to address bug fixes,

enhancements, and upgrades will be performed by or managed by the ULDB Control Center team. Changes can be requested using the ULDB Control Center Request for Change form found on the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. Requested changes will be reviewed and must be approved by both the customer and the development team before they are implemented.

Following delivery and acceptance of the systems, installation will be performed by control center operators. Software tools and maintenance guides will be provided to simplify the process of installation.

2.9 Customer Supplied Elements
This section describes those elements of the ULDB Control Center development effort that are to be supplied by the customer.

2.9.1   Funding
The customer shall provide all funding necessary to complete the project. This includes funding for all hardware, software, personnel, and facility equipment required for the project. A budget for the effort has been compiled and is available upon request from the ULDB Control Center PDL.

2.9.2   Test Environment
The customer shall provide a test facility for the integration, test, and verification of the control center. The test facility will include network connections for at least 3 systems. Access to other ULDB subsystems and test systems for TDRSS, INMARSAT, Argos, Iridium, and line of sight communication systems will be provided in the test facility.

2.10   Customer Involvement
The customer shall be the primary point of contact for the development of a concise list of requirements and functional specifications. Throughout the development of the control center the customer will continue to serve as a point of contact for questions regarding detailed requirements and operation concepts. The customer shall review all control center documentation, including requirements and design reports.

2.10.1 ULDB Project Manager
Steve Smith, Code 820 (Ira.S.Smith.1@gsfc.nasa.gov)
The ULDB Project Manager is responsible for establishing the requirements to be met by the effort. In addition, it is the Project Manager who has final authority over the acceptability of the deliverable and will approve of change in scope, acceptability of levels of risk, and modifications to schedule.

2.10.2 ULDB Mission and Operations Manager
David D. Gregory, PSL (david@master.nsbf.nasa.gov)
The ULDB Mission and Operations Manager is the primary point of contact for specific technical issues regarding formats and functionality of the existing LDB Control Center system. The Mission and Operations Manager provides guidance concerning the use of the existing system and helps to evaluate the specific technical performance of the new system against the requirements specified by the ULDB Project Manager.

2.10.3 ULDB System Engineer and Balloon-craft Manager
David W. Stuchlik, 822 (David.W.Stuchlik.1@gsfc.nasa.gov)
The ULDB System Engineer and Balloon-craft Manager is the primary point of contact for specific technical issues regarding the ULDB balloon-craft. He provides guidance with respect to the specific technical performance of the new system against the requirements specified by the ULDB Project Manager.

2.11   Customer Communications

Communication with the customer will be carried out in a variety of forms. The ULDB Control Center lead (Pamela L. Pittman) will make regular contact with the customer in order to report status, bring up development issues, and discuss design decisions. A report describing the project status, recent accomplishments, near-term plans, and problems encountered will be delivered to the customer at the end of each month.

2.12   Authority for Changes

All changes to the requirements for the project required or requested by the customer should be requested using the ULDB Control Center Request for Change form found on the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. Requested changes will be reviewed and must be approved by both the customer and the development team lead before they are implemented. If changes in requirements will result in a change in the control center development schedule, the customer will be informed of the estimated impact promptly.

All changes to the design or implementation of the project required or requested by the ULDB Control Center development team that may have schedule impacts will be forwarded to the customer in writing. Written authorization for or concurrence with the proposed changed by the customer will be required.

2.13   Acceptance Criteria

The product will be determined to be complete when it is accepted by the customer. A formal release form signed by the ULDB Control Center development team, the ULDB Project Lead, the ULDB System Engineer, and the ULDB Mission and Operations Manager will become a part of the project's quality records.

Supporting evidence of the product's readiness for acceptance will be provided by the ULDB Control Center development team. A verification checklist has been created by the development team and this checklist will be completed by the development team during the project integration and test period. This checklist, the Test and Verification Matrix, is linked to the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. A complete demonstration of the system will be performed during integration and test. This demonstration will exercise all features of the system that correspond to the documented system requirements.

2.14   Customer Agreement Review and Update Process

Changes to the requirements may be initiated by either the customer or the development team. All changes must be requested using the ULDB Control Center Request for Change form found on the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. Requested changes will be reviewed and must be approved by the ULDB Control Center development team lead, the ULDB Project Lead, the ULDB System Engineer, and the ULDB Mission and Operations Manager before they are implemented. A database will be created and maintained by the team lead to track the requested changes. The signed Request for Change forms will be preserved by the development team.

3.0 Management Approach

This section describes the management approach that will be employed in the ULDB Control Center development effort.

3.1 General Development Approach

The general development approach of the ULDB Control Center will maximize the use of Commercial Off-the-Shelf (COTS) and Government Off-the-Shelf (GOTS) products. Specifically, products that have been successfully employed for similar projects will be evaluated and reused for this effort.

3.2 Resources Needed

The development of the ULDB Control Center is expected to not exceed two full-time NASA employees. Contractor support for modifications to GOTS products specifically requested for the ULDB Control Center will also be required. These resources are formally requested and described in the code 584 Statement of Work, number 820024.

3.3 Team Organization

This section describes the organization and purpose of the ULDB Control Center development team.

3.3.1   Team Organization Chart

The following chart depicts the organization of the ULDB Control Center development team including its position relative to the customer and the Integrate Test and Operations System (ITOS) development team.
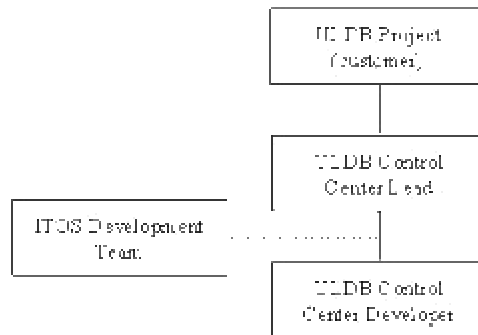
3.3.2   Team Charter

The ULDB Control Center development team will provide ULDB scientists, engineers, and mission operators with software tools with which they can monitor the status of and issue commands to ULDB instruments. The control center systems will support integration, pre-launch checkout, launch, float, and terminate operations.

3.3.3   Team Scope

The ULDB Control Center development team will procure and/or develop all hardware and software necessary for the ULDB Control Center.

3.3.4   Roles, Responsibilities, Authority, Accountability

This section describes the roles and responsibilities of the members and supporting organizations associated with the ULDB Control Center development.

3.3.4.1 ULDB Control Center Lead

Pamela L. Pittman, Code 588W (Pamela.L.Pittman.1@gsfc.nasa.gov)
The ULDB Control Center Lead is responsible for the design, development, testing, and deployment of the software meeting the requirements of the effort. The ULDB Control Center Lead will provide documentation of the product, status reports as required, and demonstrations of progress as available. The team lead will assign work to team members. Assignments will be indicated on the schedule.

3.3.4.2 ULDB Control CenterDeveloper

Debra M. Parks, Code 584W (Debra.M.Parks.1@gsfc.nasa.gov)
The ULDB Control Center Developer is responsible for supporting the ULDB Control Center Lead in the design, development, testing, and deployment of the software meeting the requirements of the effort. In addition, the ULDB Control Center Developer may provide documentation of the product, status reports as required, and demonstrations of progress as available.

3.3.4.3 ITOS Development Team

The Integrated Test and Operations System (ITOS) is a GOTS product that has been selected to serve as the basis of the ULDB Control Center. The ITOS development team will be responsible for all software included in that system. The ITOS development team will make all enhancements to the ITOS software necessary to address ULDB specific requirements.

3.3.4.4 Real Time Software Engineering Branch

Code 584
The Real Time Software Engineering Branch, as the AETD provider of engineering support for this project will provide organizational support for all aspects of the development effort. This support may include generalized development tools and development environments, documentation support, development computers, related training if available within the branch, augmentation of effort levels as required for development, internal reviews or audits, and software development standards and policies.

3.3.5   Decision Making and Conflict Resolution Process

Design decisions related to the ULDB Control Center system will be made by all members of the development team. In the event of a conflict, the ULDB Control Center lead will have final decision making authority.

3.3.6   External Support

Contractor support has been obtained for the requirements gathering phase of the project.

3.4 Team Interfaces

The ULDB Control Center development team will interface with the ULDB Flight Software development team. An Interface Control Document defining the data and command interfaces between the control center and the flight computers will be generated and approved by each team.

3.5 Development Facilities

The ULDB Control Center will be developed at Wallops Flight Facility in building N-161. Development will be conducted in both the N-161 lab and in at least one of the offices.

3.5.1   Modifications of Existing Facilitiesand Schedules
No modifications to the facilities will be required for this effort.

3.5.2   Development of New Facilities and Schedules
No new facilities will be required for this effort.

3.5.3   Physical Security
The N-161 lab is a secured room. Offices in N-161 remain locked when not in use. All government computers are password protected and on a government owned network.

3.6 Procurement
This section describes the purchases planned for the project.

3.6.1   Procurement Needs and Dates

Description	Expected Time of Purchase
3 PC systems with the Linux operating system for the OCC to serve as ITOS workstations.	delivery by June 30, 1999
1 PC with Windows NT for the OCC to serve as the Analysis workstation.	delivery by September 30, 1999
1 PC with Windows NT for the OCC to serve as a Web Server.	delivery by September 30, 1999
1 RAID system at the OCC to serve as the primary data storage system for science and balloon data.	delivery by June 30, 1999
3 PC systems with the Linux operating system for the ROCC to serve as ITOS workstations.	delivery by June 30, 1999
1 PC with Windows NT for the OCC to serve as the Analysis workstation.	delivery by September 30, 1999
SatTrack display tool to enhance the operational displays of balloon-craft position data.	delivery by September 30, 1999

3.6.2   Reference Procurement Process
Center wide processes will be used for all procurements. Purchases of hardware and/or software costing more than $2500.00 will be accomplished using the Small Purchases System (SPS). Purchases of hardware and/or software costing less than $2500.00 will be accomplished as a credit card purchase by an approved government credit card holder. All purchases will be compliant with Federal Acquisition Regulations.

3.7 Team Training Plan
Training in the use of LabView for the ULDB Control Center developer has been obtained. Informal training in the installation and operation of the ITOS software will be conducted at Wallops by representatives from the ITOS development team.

3.8 Risk Mitigation
There are a number of risk factors associated with this effort. Management of these risks is the responsibility of the ULDB Control Center Lead in conjunction with the other members of the implementation team. The major risk is the aggressive schedule.. Mitigation of the schedule risk is anticipated by the use of proven, operational, off-the-shelf software and by the development team's drawing on the experience of LDB personnel. Other risks are related to potentially unidentified, misunderstood, or

changing requirements. Reviews and status reporting will reduce risks incurred due to requirements interpretation.

3.9 Schedule

The ULDB Control Center development schedule showing the key steps and milestones associated with the development effort is included on the ULDB Control Center web page at
http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

3.10   List of Controlled Documentation

The list of documents related to the ULDB Control Center development effort that will be controlled can be found on the ULDB Control Center Documentation web page at
http://www.wff.nasa.gov/~code584/ULDBControlCenter/documentation.html.

3.11   Process for Process and Product Metric Analysis

The process of the ULDB Control Center development effort will be analyzed through regular reviews of the schedule, budget, and status of the subsystem. Peer reviews and project reviews are anticipated. The product will be reviewed during formal testing. An Acceptance Test Plan for the effort is being developed and will be published on the ULDB Control Center web page at
http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

Metrics will be collected as defined in the Information Systems Center (ISC) Product Development Handbook Appendix E (580-PG-8730.4.1). Analysis of the collected metrics will follow the ISC standard assessment process for process improvement.

The schedule will be updated monthly; a log will be maintained to record descriptions and justifications for changes to the schedule. A spreadsheet has been created to track costs for hardware, software, and contractor support. The spreadsheet includes fields for estimated expenses and actual expenses. Non-conformances will be recorded in a database. The database will include a description, a reason, and a priority of each reported non-conformance. All system changes will be described and justified in a release notice. Release notices will be maintained with the ULDB Control Center Quality Records.

4.0 Technical Approach

This section describes the technical approach that will be used to develop the ULDB Control Center.

4.1 Software Development Plan

The approach to the development of the ULDB Control Center software will be to maximize the use of Commercial Off-the-Shelf (COTS) and Government Off-the-Shelf (GOTS) products. Some legacy LDB systems and/or algorithms will be integrated into the new ULDB Control Center. Other development may be accomplished using available software development tools.

4.1.1   Major Activities

This section describes the major activities planned in the development of the ULDB Control Center. Several phases and products of the effort have been identified. For more information see the ULDB Control Center Development Schedule which is included on the ULDB Control Center web page at
http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

4.1.1.1 Phases

The development of the ULDB Control Center will include the following phases: Requirements, Design, Procurement, Development, Integration and Test, and Installation. Detailed requirements for all elements of the ULDB Control Center will be gathered during the Requirements phase. The preliminary and critical design of the system will be developed in the Design phase. Purchase requests for all hardware and software needed to support the ULDB Control Center development will be issued during the Procurement phase. The Development phase will include all ULDB specific software development. During Integration and Test, the ULDB Control Center will be integrated with other ULDB subsystems and tested against the requirements. Installation of the system will be the last phase of this effort.

4.1.1.2 Products Associated with Phases

The Requirements phase will be completed when the Requirements and Functional Specifications document is completed and accepted.

The Design phase will be completed when the Critical Design Report has been issued and a Critical Design Review has been presented and the design accepted.

The Procurement phase will be completed when all necessary purchases have been identified and issued.

The Development phase will be completed when the hardware and software needed for the project has been obtained and integrated into a system that satisfies all requirements that can be tested without integration with other ULDB subsystems.

The Integration and Test phase will be completed when the ULDB Control Center Test and Verification Matrix checklist has been completed, the Acceptance Test Plan has been implemented, and a release form has been signed by the customer and the ULDB Control Center development team.

The Installation phase will be completed when all control center systems are installed at their proper locations, tested, and ready to support the ULDB launch.

4.1.2   Development Methodology

This section describes the methodology that will be employed in the development of this product.

4.1.2.1 Methodology

The ULDB Control Center will be developed using the waterfall methodology. The product will be delivered in several phases. Periodic peer reviews will be conducted to verify the design. Prototyping will be used to verify user interface design.

4.1.2.2 Development Environment

The control center will be developed on a personal computer. The ITOS workstations used for engineering and operational control and monitoring will use the Linux operating system. The analysis workstation will use the Windows NT operating system.

4.1.2.3 Utilized Standards

Data received by the control center is expected to conform to the Consultative Committee for Space Data Systems (CCSDS) format.

4.1.2.4 Utilized COTS Products and Tools

A number of COTS products have been selected for use in the ULDB Control Center project. All hardware for all ULDB Control Center systems will be off the shelf. The Linux and Microsoft Windows NT operating systems have been included in the design. SatTrack, an off the shelf positional display tool will be used to enhance operational displays of balloon-craft position. Microsoft Access and Microsoft Excel will be used on the analysis workstations to provide scientists and engineers with data analysis tools.

4.1.2.5 Build Strategy

The system will be built and released in a single build with system changes and re-releases performed as required.

4.1.2.6 Product Inspection and Test Approach

Testing of each module will be the role of the ULDB Control Center development team. A Test Plan will be developed that will describe the process by which all modules will be tested against documented ULDB Control Center requirements

Supporting evidence of the product's readiness for acceptance will be provided by the ULDB Control Center development team. A verification checklist has been created by the development team and this checklist will be completed by the development team during the project integration and test period. This checklist, the Test and Verification Matrix, is linked to the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. A complete demonstration of the system will be performed during integration and test. This demonstration will exercise all features of the system that correspond to the documented system requirements.

Prior to delivery of the final system, a Beta version will be delivered to and evaluated by ULDB Operations personnel. The Beta system will be used in parallel with existing, accepted LDB systems for a LDB flight under the observation of the development team to identify issues of correctness and usability. Findings will be addressed prior to operational release.

4.1.2.7 Acceptance Criteria and Objectives

A verification checklist has been created by the development team and this checklist will be completed by the development team during the project integration and test period. This checklist, the Test and Verification Matrix, is linked to the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

4.1.2.8 Reviews Planned

The key components of the review cycle include a requirements analysis, to be performed and documented by the development organization, preliminary and critical design reviews, status review, and a system readiness review.

4.1.2.8.1   Requirements Analysis
The requirements analysis will identify project requirements and assess their completeness, clarity and correctness. The product of this analysis will be the <u>ULDB Control Center Requirements and Functional Specifications</u> document. This document will be reviewed and signed by the ULDB Project Lead, the ULDB Systems Engineer and Balloon-craft Manager, the ULDB Mission and Operations Manager, the ULDB Control Center development team, and the ULDB Flight Software development lead.

4.1.2.8.2   Design Reviews
Preliminary and Critical design reviews will assess the applicability of the specific system design and implementation plan. These reviews will provide an external view of the development effort and will insure that the implementation strategies and designs make maximum use and reuse of COTS and other off-the-shelf systems or technologies and minimize risks associated with the effort. The review panel will be made up of individuals selected by the Balloon Projects Office.

4.1.2.8.3   Status Reviews
Status reviews will be held as required by the project and will provide both project and management personnel with a current status of all aspects of the project. Each review will identify areas of progress, areas of completion, areas of lag, and changes to requirements, schedule, budget, or functionality to be delivered. The review panel will be made up of individuals selected by the Balloon Projects Office.

4.1.2.8.4   System Readiness Review
The System Readiness review will establish that the system design and implementation has met the requirements and can be released for operational use. The review panel will be made up of individuals selected by the Balloon Projects Office.

4.1.3   Incoming Inspection and Test

Kind, count, and condition of purchased hardware products is planned. The Goddard Receiving, Inspection, and Test System (RITS) will be the primary tool to develop records documenting compliance with the requirements contained in GPG 4520.2.

4.1.4   Control of Test Equipment

Test equipment for the TDRSS and INMARSAT data interfaces will be used in integration and test of the control center. This equipment will be provided and controlled by the ULDB project management team.

4.2 Process for Transportation, Identification, and Medium of Product

The NASA/GSFC center process for transportation will be used to transport all ULDB Control Center products. All software modules released with the ULDB Control Center will be identified by a unique version number. The medium of the product is described in Section 2.6 of this document.

4.3 Technology and Commercialization Plan

There is no technology and commercialization plan at this time.

4.4 Servicing – Process for Product Maintenance

Servicing of all COTS hardware and software will be covered under the respective product warranties. Servicing of all GOTS software will be performed by the supplier of that software.

Maintenance of the integration of all off the shelf products will be performed by the ULDB Control Center development team.

5.0 Product Assurance

This section describes the processes and procedures that will be followed in order to assure that the product developed satisfies the customer's requirements.

5.1 Assumptions and Constraints

It is assumed that all GOTS products employed in the ULDB Control Center will be ISO 9001 compliant. The supplier of each GOTS product is expected to maintain quality records related to the product. It is assumed that all COTS products will meet or exceed all specifications included in the purchase request.

5.2 Quality Assurance

This section describes the processes and procedures that will be followed in order to assure that the customer receives a quality product.

5.2.1   Control of Non-Conforming Products

Prior to release and acceptance of the system, non-conforming products will be reported using the ULDB Control Center Request for Change form found on the ULDB Control Center web page. Following release and acceptance of the system by the customer, changes will be tracked using the Center Level Non Conformance Reporting (NCR) system.

Reports of nonconformance will be reviewed, tracked, and maintained by the development team. An assessment of the impact of the nonconformance to the schedule, budget, and delivery of the product will be made by the development team and reported to the customer. Changes made to the system in response to a nonconformance report will be maintained by the ULDB Control Center development team.

The customer will have the authority to use or refuse to use the product in an operational environment.

5.2.2   Corrective and Preventative Action

Errors will be reported using the ULDB Control Center Request for Change form found on the ULDB Control Center web page. Reports of nonconformance will be reviewed, tracked, and maintained by the development team. An assessment of the impact of the nonconformance to the schedule, budget, and delivery of the product will be made by the development team and reported to the customer. Implementation of changes will be done according to the priority defined by the ULDB Project management.

All system changes will be verified using Test and Verification Matrix before system release.

5.2.3   Control of Quality Records

The ULDB Control Center lead will be both the Quality Records Coordinator and the Quality Records Custodian. A list of the quality records will be linked to the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html.

5.2.4   Control of Documents and Data

All documents generated by the ULDB Control Center development team are controlled by the ULDB Control Center lead.

5.3 Configuration Management

Configuration management procedures will be applied to all components delivered or developed during this effort. Subsequent builds or deliveries will result in incremental versions of the system.

Changes to archived or installed software following the initial delivery must be requested using the ULDB Control Center Request for Change form on the ULDB Control Center web page at http://www.wff.nasa.gov/~code584/ULDBControlCenter/index.html. All changes will be reviewed by the ULDB Control Center development team. An estimate of the schedule and budget necessary to effect the requested change will be made and presented to the ULDB Project management. Implementation of changes will be done according to the priority defined by the ULDB Project management.

5.3.1   Identification and Traceability of Products

A formal release form signed by the ULDB Control Center development team, the ULDB Project Lead, the ULDB System Engineer, and the ULDB Mission and Operations Manager will become a part of the project's quality records. The release form will include an identification of components that comprise the released product as well as any known constraints or restrictions.

5.3.2   Control of Customer Supplied Elements

Control of funding and test equipment shall reside with the customer.

6.0 Plan Update History

Version	Date	Description	Affected Pages
1.0	December 7, 1998	Original	All
2.0	February 16, 1999	Additional sections completed.	All
2.1	April 13, 1999	Signature page added and sections 3.11, 5.2.1, 5.2.2 updated.	9, 13
2.2	April 16, 1999	Updated following ISC Management review.	All
2.3	June 25, 1999	Updated to include additional information requested by project.	3, 4, 8
2.4	February 10, 2000	Updated to include identification of Quality Records Coordinator and Custodian.	14